

Claims

1. A polynucleotide sequence which encodes a HPV amino acid sequence,
wherein the codon usage pattern of the polynucleotide sequence resembles that of
highly expressed mammalian genes.
2. The polynucleotide sequence according to claim 1 in which the codon usage
pattern of the polynucleotide sequence resembles that of highly expressed human
genes.
3. The polynucleotide sequence according to claim 1 in which the codon usage
pattern of the polynucleotide sequence also resembles that of highly expressed
E. coli genes.
4. The polynucleotide sequence according to claim 1 which is a DNA sequence.
5. The polynucleotide sequence according to claim 1 which encodes a HPV
polypeptide of an HPV type or sub-type associated with cervical cancer, benign
cutaneous warts or genital warts.
6. The polynucleotide sequence according to claim 5 which encodes a HPV
polypeptide of one of types 1-4, 6, 7, 11, 16, 18, 26-29, 31, 33, 35, 39, 45, 51,
52, 56, 58, 59, and 68.
7. The polynucleotide sequence according to claim 6 which encodes a HPV
polypeptide of an HPV type or sub-type which is associated particularly with
cervical cancer or genital warts.
8. The polynucleotide sequence according to claim 7 which encodes a HPV
polypeptide of one of types 6, 11, 16, 18, 33 or 45, or a fusion of two or more
polypeptides of one or more of HPV virus types 6, 11, 16, 18, 33 or 45.
9. The polynucleotide sequence according to claim 8 which encodes a HPV
polypeptide of a HPV type or sub-type selected from HPV 11, 6a or 6b.
10. The polynucleotide sequence according to claim 1 which encodes a mutated
HPV polypeptide having reduced biological function.
11. The polynucleotide sequence according to claim 1 which encodes a mutated
HPV polypeptide comprising one or more point mutations by which one or more of
the polypeptide's natural biological functions is inactivated.
12. The polynucleotide sequence according to claim 1 in which the encoded HPV
polypeptide comprises the whole or a part of a HPV early gene product.

13. The polynucleotide sequence according to claim 12 in which the encoded HPV polypeptide comprises the whole or a part of E1 or E2, or a fusion of the whole or a part of E1 or E2 with another HPV polypeptide.
- 5 14. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.3 but less than 1.
15. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.4 but less than 1.
- 10 16. The polynucleotide sequence according to claim 2 having a codon usage coefficient for highly expressed human genes of greater than 0.5 but less than 1.
- 15 17. The polynucleotide sequence according to claim 3 having a codon usage coefficient for highly expressed E. coli genes of greater than 0.6.
18. A polynucleotide sequence as set out in Fig. 5a and 5b, or a fragment or analogue thereof which maintains the codon usage pattern thereof.
- 20 19. A polynucleotide sequence as set out in Fig. 6, or a fragment or analogue thereof which maintains the codon usage pattern thereof.
20. An expression vector comprising a polynucleotide sequence according to claim 1 operably linked to a control sequence which is capable of providing for the expression of the polynucleotide sequence by a host cell.
- 25 21. The expression vector according to claim 20 which is capable of directing the expression of the polynucleotide sequence in bacterial, insect or mammalian cells.
- 30 22. The expression vector according to claim 20 which is p7313PLc.
23. A host cell comprising a polynucleotide sequence according to claim 1.
24. A host cell comprising an expression vector according to claim 20.
- 35 25. A host cell according to claim 23 or claim 24 which is a bacterial, mammalian, or insect cell.
26. A pharmaceutical composition comprising a polynucleotide sequence according to claim 1.
- 40 27. A pharmaceutical composition comprising a vector according to claim 20.
28. A pharmaceutical composition according to claim 26 or claim 27 comprising a plurality of particles, preferably gold particles, coated with DNA.
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29. A pharmaceutical composition according to claim 27 further comprising a pharmaceutically acceptable excipient.
- 5 30. A pharmaceutical composition according to any one of claims 26, 27, or 29 further comprising an adjuvant.
31. A pharmaceutical composition according to claim 28 further comprising an adjuvant.
- 10 32. A pharmaceutical composition according to claim 30 in which the adjuvant is encoded as a fusion with the HPV polypeptide encoded by the polynucleotide.
33. A pharmaceutical composition according to claim 31 in which the adjuvant is encoded as a fusion with the HPV polypeptide encoded by the polynucleotide.
- 15 34. A method of treating or preventing HPV infections or any symptoms or diseases associated therewith, comprising administering an effective amount of a polynucleotide according to claim 1, a vector according to claim 20 or a pharmaceutical composition according to claim 26 or 27.
- 20 35. A method of treating or preventing HPV infections or any symptoms or diseases associated therewith, comprising administering a pharmaceutical composition according to any one of claims 26 or 27 in a prime-boost dosage regime with a recombinant viral vector or non-viral based system comprising a polynucleotide
- 25 according to claim 1.